

PATENT SPECIFICATION

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(54) PROCESS FOR THE PRODUCTION OF STABLE, AQUEOUS EMULSIONS OF WATER — INSOLUBLE SUBSTANCES

(71) We, CHEMISCHE FABRIK PFERSEE GMBH, a German Joint Stock Company, of 8900 Augsburg, Farberstrasse 4, Germany, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a process for the manufacture of stable, aqueous emulsions of substances which are insoluble in water.

Various processes for emulsifying water-insoluble substances are known. The general procedure is for the substance to be finely dispersed in water in the presence of a wetting agent or emulsifier. In such cases, the distribution or dispersion can be effected simply by shaking or by vigorous stirring. Usually, however, stirring the constituents together yields only a coarsely dispersed pre-emulsion which thereafter have to be transformed into finely dispersed emulsions with homogenisers. Homogenisers are high-pressure emulsifying machines ultrasonic emulsifiers and vibrators which may be constructed in accordance with various principles (see for example: in Ullmanns Encyklopädie der Technischen Chemie, 3rd Edition, Vol. 6 (1955), pages 502 to 503, Verlag Urban & Schwarzenberg, Munich-Berlin). The emulsions thus obtained are often unstable and in order to obtain stable emulsion a considerable expenditure for equipment and multi-stage operating procedures is necessary. Moreover, it is often also necessary to use organic solvents in order to adapt the viscosity of the internal phase to the external phase. An additional disadvantage of such processes is that only a relatively small quantity of water-insoluble substances can be emulsified and as a result comparatively dilute emulsions are obtained.

German Auslegeschrift No. 1,644,952 discloses a process for the production of aqueous

emulsions of highly viscous, hydrophobic oils in which a mixture of the highly viscous oil, an emulsifier and small quantity of water is exposed to high shearing forces by means of a roller-type kneader. This known process yields concentrated but coarsely dispersed emulsions and is only suitable for emulsifying highly viscous oils. Water-in-soluble substances of low or medium viscosity cannot be emulsified by this procedure. The stability of the emulsions which are prepared by such a process leaves much to be desired, particularly in aqueous dilution.

It is an object of the present invention to provide a process by which it is possible for also water-insoluble substances of low to medium viscosity to be transformed into stable emulsions.

Therefore according to the present invention there is provided a process for the production of stable aqueous emulsions of low to medium viscosity, water-insoluble substances comprising forming a mixture comprising:

- 2 to 30% by weight of emulsifier based on the water-insoluble substance,
- 2 to 25% by weight of water based on the water-insoluble substance, the weight ratio of water to emulsifier being in the range 0.4:1 to 1.7:1, and

optionally a part of the water-insoluble substance to form a pre-emulsion, gradually adding to the mixture the or the remainder of the water-insoluble substance during which the mixture is subjected to mechanical mixing, the mechanical mixing being continued until a homogenous mass is formed.

The term "low to medium viscosity" as used herein qualifying the water-insoluble substances means those substances which have a viscosity in the range 20 to 10000 cp (corresponding to 0.02 to 10 pascal seconds) at a temperature in the range 15 to 32° C. There-

fore, these substances are liquid to viscous in this temperature range and can be pumped without any difficulty.

5 The process according to the invention allows highly concentrated, stable emulsions of water-insoluble substances of low to medium viscosity to be produced. The emulsion may be made advantageously in a single working
10 step and the cost of equipment used may be extremely low as compared with that used in the prior processes. The process according to the invention is also particularly advantageous, because the use of foreign solvent is avoided. With emulsions of organohydrogen poly-
15 siloxanes, amount of hydrogen cleavage occurring in the process of the invention is particularly small in relation to emulsified organopolysiloxane. Furthermore, due to the high content of active substance, the extremely
20 stable emulsions which are obtained offer important commercial advantages, which are to be particularly seen in the reduction of the packaging, transporting and storage costs.

25 The prior art does not teach that it would be possible successfully in this simple manner for substances of low to medium viscosity to be transformed into stable emulsions. According to the prior art, the preliminary condition for the emulsification with the sole action of
30 shearing forces was in fact that only highly viscous substances are emulsified. It was only with emulsification of these substances that the establishment of sufficiently high shearing forces could be expected. Surprisingly, it has
35 now been shown that, by maintaining the features of the present process, water-insoluble substances with a viscosity lower than 10,000 cP may be emulsified in a simple manner.

40 The preferred water-insoluble substances which are emulsified by the process of the invention are organopolysiloxanes. These include alkyl-hydrogen polysiloxanes, e.g. methyl-hydrogen and ethylhydrogen poly-
45 siloxanes, dialkyl polysiloxanes, e.g. dimethyl and diethyl polysiloxanes and the mixtures thereof. Also, suitable cohydrolysates of silanes, which contain hydrogen bonded to silicon, with silanes containing no hydrogen
50 bonded to silicon can be emulsified. The organopolysiloxanes generally have a viscosity from 30 to 1000 cP at 20° C. In addition, organopolysiloxanes of higher viscosity, namely, up to 10,000 pP at 20° C, may be
55 emulsified by the process of the invention. These include dialkyl, more particularly dimethyl, polysiloxanes which are modified by special substituents and which can still contain small amounts of silicon-bonded hydrogen. The methyl groups may in such a case be
60 substituted by phenyl groups, unsaturated organo groups, e.g. vinyl groups and the like. Such polymers may also carry reactive groups, more especially hydroxyl groups, in the end position. The emulsifying of organopoly-

siloxanes by the process of the invention is particularly preferred. 65

Other water-insoluble substances include oil-like and fat-like substances, provided they show the required viscosity at temperature up to 32° C. Examples include oils, paraffin oils,
70 low-melting waxes and fats and their free fatty acids. Liquid or low-melting aminoplast resins or modified aminoplast resins such as those described in United States Patent Specification No. 3,506,661 are also included. Organometallic compounds which are liquid
75 or melt at low temperature e.g. dibutyl-tin dilaurate and dibutyl-tin diacetate can be emulsified by the process of the invention.

80 Suitable emulsifiers for use in the invention are non-ionic, cationic and anionic compounds. Non-ionic emulsifiers include the ethylene oxide reaction products of higher fatty acids, fatty alcohols, fatty acid amides and fatty amines. The ethoxylation products
85 of the higher amines can also be used in the form of their salts with low carboxylic acids, such as acetic, formic and propionic acids, or mineral acids, such as hydrochloric acid or sulphuric acid. Polyvinyl alcohols in aqueous
90 solution may also be considered as non-ionic emulsifiers.

Specific examples of such non-ionic emulsifiers are: ethoxylated coconut fatty amine with 5 or 15 ethylene oxide groups, ethoxylated
95 stearyl amine or oleyl amine with 5, 10 or 30 ethylene oxide groups, ethoxylated dodecyl and hexadecyl amines with 6 ethylene oxide groups, or the acetates or chlorides of these compounds, ethoxylated (N-stearyl)- or (N-hexadecyl)-trimethylene diamine with 10
100 ethylene oxide groups, ethoxylated oleic acid monoethanolamide with 4 ethylene oxide groups, ethoxylated stearic acid amide with 12 ethylene oxide groups, ethoxylated coconut fatty acid propanolamide with 15 or 25
105 ethylene oxide groups, ethoxylated oleic acid monoethylamide with 10 ethylene oxide groups, ethoxylated cetyl, stearyl or oleyl alcohols with 10 to 25 ethylene oxide groups and lauric acid, palmitic acid, stearic acid, oleic acid, benhenic acid and ricinoleic acid with 10, 15 or 30 ethylene oxide groups. As
110 shown by the example, the hydrocarbon radicals of the ethoxylated compounds may be both saturated and unsaturated and comprise at least 12 carbon atoms in the chain. The chain can also be substituted for example by OH groups. Preferred emulsifiers are those which contain 12 to 20 carbon atoms in the hydrocarbon radical and are ethoxylated with
115 5 to 15 ethylene oxide groups. The stated numbers of ethylene oxide in this case indicate the number of mols for each mol of amine, amide, carboxylic acid or alcohol, this also
120 being the case in the examples.

Suitable cationic emulsifiers are quaternary ammonium compounds. Examples of such

compounds are: cetyl- or lauryl-benzyl dimethylammonium chloride, hexadecyl-(dichlorobenzyl) dimethylammonium chloride, octadecyl oxymethyl- and hexadecyl-oxymethyl

pyrrolidinium chloride and also lauryl oxymethyl-N- β -hydroxyethyl morpholinium chloride. The emulsifiers which are referred to in British Patent Specification No. 1,412,598 are also suitable.

Suitable anionic emulsifiers include alkyl and alkaryl sulphonates, dialkyl sulphosuccinates and also alkyl sulphates. Specific examples are octyl, dodecyl and octadecyl sulphonates mineral oil sulphonate and paraffin sulphonate, di-(2-ethylhexyl)- and di-(tri-decyl)-sodium sulphosuccinate, as well as cetyl and oleyl sulphates. For neutralising the sulphonates and sulphates, it is possible to use amines, such as propyl amine, monoethanolamine and triethanolamine as well as conventional aqueous alkali solutions e.g. sodium hydroxide or potassium hydroxide solutions.

The non-ionic and cationic emulsifiers are preferred. The quantity of emulsifier used in the present invention is in the range 2 to 30%, preferably 8 to 20% and more preferably 10 to 18% by weight, based on the weight of water-insoluble substance.

The emulsifying of the water-insoluble substances takes place in the presence of a small quantity of water. The water is present in an amount of 2 to 25%, preferably 6 to 18% by weight and more preferably 6 to 14% by weight based on the weight of insoluble substance. The quantity of water is independent of the viscosity of the water-insoluble substance which is to be emulsified, but is solely dependent on the quantity of emulsifier being used. The weight ratio of water to emulsifier is in the range 0.4:1 to 1.7:1. A particularly reliable operation, with which particularly stable emulsions are formed, is when the weight ratio of water to emulsifier is in the range 0.5:1 to 1:1.

The water/emulsifier mixture advantageously adjusted to a pH value from 1.5 to 5.5, preferably 2.5 to 4 with, for example, hydrochloric, sulphuric or formic acid. The water-insoluble substance which is of low to medium viscosity is then slowly admixed and the mixture subjected to high shearing forces. The viscosity of the mixture rises as a result of adding the water-insoluble substance, so that the shearing forces caused by the mechanical movement become increasingly effective. With an addition of about 5% by weight of the water-insoluble substance, the viscosity may increase to such an extent that the mixing of the additional water-insoluble substance and the distribution thereof in the mixture is sufficiently achieved by the shearing forces. Generally the strong shearing forces become effective from a viscosity of 2000—3000 cP. The preferred range for the prepara-

tion of a pre-emulsion in a first step is at 10 to 30% by weight, preferably 10 to 20% by weight of water-insoluble substance. The admixing of the remaining water-insoluble substance in a second step may immediately thereafter be carried out without any interruption when using the preferred working method.

During the addition of the water-insoluble substance, the mixture is subjected to increasingly strong shearing forces with steady stirring or kneading. With substances of low viscosity, the complete admixing operation last about 2 to 5 and more particularly 3 to 4 hours, and with substances of medium viscosity, i.e. with substances having a viscosity of about 500 to 10,000 cP at 20° C, the time is about 5 to 9 hours, more particularly 6 to 8 hours. The times indicated apply to respect of the supply of about 1200 kg of water-insoluble substance.

Depending on the substance which is to be emulsified, it is necessary in certain circumstances for cooling or even also for heating to take place during the addition thereof. With substances having viscosities which are higher than about 3000 cP, the heat evolved by friction may be so great that gentle cooling is necessary. With substances which are only capable of flowing at moderately raised temperature, it is necessary to apply heat although the temperature should not be chosen to be higher than absolutely necessary. The temperature during the emulsification is preferably in the range 15 to 45° C.

At the conclusion of the addition of the water-insoluble substance, the action of the shearing forces is continued e.g. for a further 1 to 2½ hours in order to obtain a uniform, homogenous emulsion. Finally, for the purpose of easier handling, it is expedient that highly concentrated emulsions, which may contain up to about 95% by weight of water-insoluble substance in emulsion form and are in the form of highly viscous pastes, to be diluted with water. In this respect, the dilution with water is generally carried out to a concentration of 50 to 85% by weight of water-insoluble substance. Thus when using the process according to the invention, extremely concentrated emulsions are even obtained after the dilution. After mixing in the water, which generally takes 3 to 5 hours, the prepared concentrates are drawn off. It is also possible, but less suitable, for the first and second steps to be separated, i.e., for the pre-emulsion to be separately prepared and for the admixing of the residual water-insoluble substance to be carried out later in a second step while stirring, kneading or the like. The emulsions are obtained in accordance with the invention may be used for many purposes depending on the substance which is emulsified. Emulsions of organopolysiloxanes and paraffin oils serve, for example

as hydrophobing agents for fibre materials. Organopolysiloxane emulsions are also used for coatings and coverings. Emulsions of organometallic compounds are employed as hardening catalysts. The emulsions of oil-like and fat-like compounds are, *inter alia*, suitable as a base for cosmetic preparations. Amino-plast resins emulsified by the process of the invention, serve, for example, as finishing and impregnating agents.

The process in accordance with the invention can be carried out in various kinds of apparatus. The invention will now be illustrated with reference to the accompanying drawing which represents a flow diagram for the process according to the invention in its preferred form.

The water-emulsifier mixture is initially introduced into the stirrer-type vessel (5). The water-insoluble substance passes from the supply tank (1) via the measuring of injection pump (2) and the pipe (3a), and also advantageously pipe (3b), into the stirrer-type vessel (5) which may be capable of being heated or cooled. A mixing or blending device (4) is optionally additionally arranged on this vessel (5) in the lower third thereof. The prepared emulsion passes by way of the outlet (6) and the device (7), the function of which will later be explained, into the storage container.

Any kneader or vessel provided with a stirrer mechanism is suitable as stirrer-type (5), provided its stirrer mechanism is capable of moving thickly viscous masses. The shape of the vessel is of subordinate importance. The vessel, which is advantageously provided with a casing or jacket for cooling or heating purposes, can be provided with a simple anchor-type stirrer mechanism, a blade-type stirrer, frame-type stirrer or two-shaft stirrer. Particularly preferred are vessels which are equipped with a planetary stirrer mechanism, since in such a case particularly high shearing forces are operative on the mixture (see "Ullmanns Encyklopädie der Technischen Chemie," 4th Edition, Vol. 2, (1972), pages 289/290, Verlag Chemie, Weinheim-Bergstrasse). The additional fitting of wall strippers for ensuring the thorough mixing of the total mass is also advantageous.

The separately driven mixing or blending device (4) is of considerable importance for the preparation of the pre-emulsion of the first step. If in fact the water-insoluble substance is added without this additional device, then the mixing operation, particularly in the first step, takes a long time. However, when working with the use of the additional blending device (4), it is possible to achieve a rapid incorporation of the water-insoluble substance into the emulsifier/water mixture. In the simplest case, the blending device (4) is a distributor disc or plate. This distributor disc or plate can be modified in many different

forms, for example, by the provision of protuberances, serrations, the fitting of pins (lump crushers), etc. A particularly effective mixing or blending is obtained when the distributor disc is in the form of a toothed disc having teeth which are set facing one another. The preparation of the emulsion is successfully achieved in a particularly advantageous and quick manner when the water-insoluble substance is directed on to the distributor disc, more particularly the toothed disc, and as a result is directly incorporated into the mixture which is present.

One preferred apparatus for carrying out the process according to the invention is described in British Patent Specification No. 1,041,619. The mixing container, equipped with a planetary worm-type stirrer mechanism, is modified in a particularly advantageous manner for the process of the invention and in accordance with Figure 1 by the incorporation of a blending device (4).

In order to handle the highly viscous emulsion easily, the latter is preferably diluted with water and stirred for a further period of time. The uniform distribution of the highly viscous mass in the dilution water takes a considerable time. In order to reduce this time period, a device (7) is preferably connected on the output side, which effects a comminution of more highly concentrated fractions which are still present and simultaneously undertakes the conveying of the prepared concentrate. All devices which are able to move substances of relatively high viscosity, for example, colloid mills, gearwheel pumps and the like, are suitable (see "Ullmanns Encyklopädie der Technischen Chemie," 3rd Edition, Vol. 1 (1951), pages 79—85 and 637/638, Verlag Urban & Schwarzenberg, Munich-Berlin). Screw pumps are particularly suitable.

The explanations so far given are applicable to the preferred method of procedure, with which the 1st and 2nd steps are undertaken without any interruption. However, it is also readily possible for the pre-emulsion to be separately prepared (1st step), for example, by combining the emulsifier/water mixture and a part of the water-insoluble substance by way of a pump. In this case, it is particularly preferred to carry out the thorough mixing or blending by means of a screw or gearwheel pump and thereafter to introduce the mixture into the stirrer-type vessel and to produce therein highly concentrated emulsion by mechanical motion, as indicated, by addition of the remainder of the water-insoluble substance (2nd step), whereafter the emulsion is possibly diluted by adding water and as a result the final concentrate is obtained.

The invention will now be illustrated, by the following Examples.

Example 1.

The mixing apparatus used in this Example was a screw-type mixer such as described in British Patent Specification 1,041,619 (Figure 1) capacity 4000 litres, which was modified by the inclusion of a blending device (4) in the form of a toothed disc.

A mixture of 160 kg of emulsifier (ricinoleic acid polyglycolester with on average 9 ethylene oxide groups) and 80 kg of water (adjusted with hydrochloric acid to pH of 3) was initially placed in the mixing apparatus, and a mixture of 960 kg of methyl-hydrogen polysiloxane (viscosity 30 cP at 20° C) and 240 kg of dimethyl polysiloxane (viscosity 750 cP at 20° C) was slowly pumped via the injection pump (2) over a period of 3½ hours on to the toothed disc and, with the planetary stirrer mechanism switched on. During the addition of the water-insoluble substance, there was a marked increase in the

viscosity. After the addition was completed the stirring was continued for a further hour. Throughout the entire operation, the temperature was maintained at 20 to 25° C. Thereafter 280 kg of water were admixed in portions over a period of 4 hours followed by stirring for a further hour and then the highly concentrated emulsion obtained was discharged by a screw pump. A white, opalescent emulsion was obtained, which is stable at least 6 months.

Upon dilution to a content of 35% by weight of organopolysiloxane, the emulsion obtained showed a considerable mechanical resistance; even after being agitated for one hour on the shaker machine, no change can be detected. The resistance to temperature of this emulsion was also excellent, since the homogeneity of the emulsion was unchanged, even after storage for three months at 40° C.

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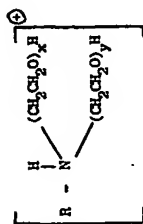
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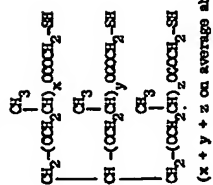
- 2) oleic acid ethoxylated with 20 ethylene oxide
- 3) cetyl benzyl dimethylammonium chloride
- 4) triethanolamine salt of dodecyl-benzene sulphonic acid
- 5)

Examples 2 to 6.
The operating procedure of Example 1, was repeated in a 2000 litre stirrer-type vessel with the substances indicated in the following Table and under the conditions referred to therein.

1)



CH_3COO^- (R = on average 16 C-atoms: $x + y = 10$)



TABLE

Example	Initial emulsifier/water mixture		Water-insoluble substance		Temp. in °C	Time of addition in hours	Subsequent stirring time in hours	H ₂ O addition for dilution in kg
	kg H ₂ O	Emulsifier	Nature of substance	Viscosity at 20°C				
2	50	as Example 1	Prod. as in Example 1 of U.S. Patent 3506661	about 9800 cP at 30°C	about 40	4.5	1	100
3	80	1) see below	Dibutyltin dilaurate	about 100 cP	about 20	2	1.5	100
4	220	2)	α,ω -dihydroxy-dimethyl polysiloxane	about 6000 cP	about 35	6	2	250
5	100	3)	5)	about 1000 cP	about 25	3	1	120
6	100	4)	Dimethyl polysiloxane	100 cP	about 20	1.5	0.75	150

- 15 Example 7.
A mixture of pH 4.0, adjusted with dilute sulphuric acid, consisting of 70 kg (N-stearyl)-trimethylene diamine ethoxylated with 12 ethylene oxide as emulsifier and 100 kg of water was introduced into a 2000 litre Unimix

mixer with a planetary motion and manufactured by Haagen and Rinau, Bremen (see "Ullmanns Encyklopädie der Technischen Chemie," 4th Edition, Vol. 2 (1972), page 290) and having jacket heating. With the planetary stirrer mechanism running, 800 kg of paraffin oil (viscosity about 70 cP at 20° C) were added to this mixture in 4.0 hours at a temperature of 28° C. The viscosity slowly increased and after adding 100 kg, the viscosity had risen to such an extent that the shearing forces became effective to an increasing degree. After completing the addition, stirring was continued for a further hour and the emulsion was then diluted with 320 kg of water, which is added in portions over 2½ hours, whilst cooling the emulsion to about 20° C. The concentrated emulsion obtained was resistant to heat and cold.

The addition of the paraffin oil may be shortened by 1½ hours if a distributor disc is installed in the lower part of the vessel, the disc being switched on during the first stage of the emulsification, i.e. until 160 kg of paraffin oil are added.

If a toothed disc is fitted as distributor disc, the addition of all the paraffin oil can again be carried out more quickly by half an hour.

Example 8.

An emulsifier/water mixture comprising 20 kg of octadecyl oxymethyl pyridinium chloride and 16 kg of water; pH value=3.0 was uniformly mixed by means of a gearwheel pump with 18 kg of olive oil (viscosity about 40 cP at 20° C) with a throughput of altogether 20 kg per hour (mixing ratio 2:1), and then pumped into a stirrer-type vessel having a powerful anchor stirrer mechanism. Another 170 kg of olive oil were slowly stirred into this pre-emulsion over a period of 40 minutes and the highly viscous emulsion which was obtained were stirred for a further hour. In order to facilitate the withdrawal of an emulsion, 40 kg of water were admixed therewith over a period of 2 hours. The concentrate was drawn off via a colloid mill. The concentrated emulsion obtained possessed high heat resistance and mechanical resistance.

Example 9.

10 g of ricinoleic acid polyglycol ester (10 mol ethylene oxide per mol ricinoleic acid) and 10 g of ethoxylated stearyl amine acetate (15 mol ethylene oxide per mol stearyl amine) were stirred into 30 g of water in a 500 ml beaker having an accurately fitting screw-type stirrer. 200 g of basic zirconium fatty acid compound (24.5% ZrO₂, fatty acid residue on average 10 C-atoms, viscosity about 1300 cP at 20° C) were stirred into this mixture over a period of 2 hours while cooling gently, to ensure room temperature was maintained. The viscosity of the mixture rose sharply.

Thereafter, 35 g of water were added in portions over a period of 20 minutes under stirring conditions and the stirring maintained for a further 5 minutes. The paste thus obtained and containing 70% by weight of zirconium compound was stable in storage and was miscible in any proportion with water.

The word "Unimix" is a registered Trade Mark.

WHAT WE CLAIM IS:—

1. A process for the production of stable aqueous emulsions of low to medium viscosity, water-insoluble substances comprising forming a mixture comprising:

2 to 30% by weight of emulsifier based on the water-insoluble substance,

2 to 25% by weight of water based on the water-insoluble substance, the weight ratio of water to emulsifier being in the range 0.4:1 to 1.7:1, and

optionally a part of the water-insoluble substance to form a pre-emulsion,

gradually adding to the mixture the or the remainder of the water-insoluble substance during which the mixture is subjected to mechanical mixing, the mechanical mixing being continued until a homogenous mass is formed.

2. A process as claimed in Claim 1 in which the mixture comprises 8 to 20% by weight of emulsifier based on the weight of water-insoluble substance.

3. A process as claimed in Claim 2 in which the mixture comprises 10 to 18% by weight of emulsifier based on the weight of water-insoluble substance.

4. A process as claimed in any preceding claim in which the mixture comprises 6 to 18% by weight of water based on the weight of water-insoluble substance.

5. A process as claimed in Claim 4 in which the mixture comprises 6 to 14% by weight of water based on the weight of water-insoluble substance.

6. A process as claimed in any preceding claim in which the weight ratio of water to emulsifier is in the range 0.5:1 to 1:1.

7. A process as claimed in any preceding claim in which a pre-emulsion is prepared in a first step with part of the water-insoluble substance and the remainder of the water-insoluble substance is admixed in a second step.

8. A process as claimed in Claim 7 in which the pre-emulsion is prepared with 10 to 30% by weight of the water-insoluble substance.

9. A process as claimed in Claim 8 in which the pre-emulsion is prepared with 10 to 20% by weight of the water-insoluble substance.

10. A process as claimed in any of Claims 7 to 9 in which the second step is carried out

directly following the first step.

11. A process as claimed in any preceding claim in which the water-insoluble substance is a polysiloxane.

5 12. A process as claimed in any preceding claim comprising the additional step of diluting the emulsion with water under stirring conditions.

10 13. A process for the production of stable aqueous emulsions of low to medium viscosity, water-insoluble substances substantially as herein described with reference to any of the Examples.

14. A process for the production of stable

aqueous emulsions of low to medium viscosity, water-insoluble substances substantially as herein described with reference to the accompanying drawing. 15

15. A stable aqueous emulsion of a low to medium viscosity, water-insoluble substance when prepared by the process as claimed in any preceding claim. 20

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COMPLETE SPECIFICATION

1 SHEET

*This drawing is a reproduction of
the Original on a reduced scale*

